EMU - CSC Production at FNAL

Giorgio Apollinari

Fermilab

Oct. 5-6, 2001 - FNAL

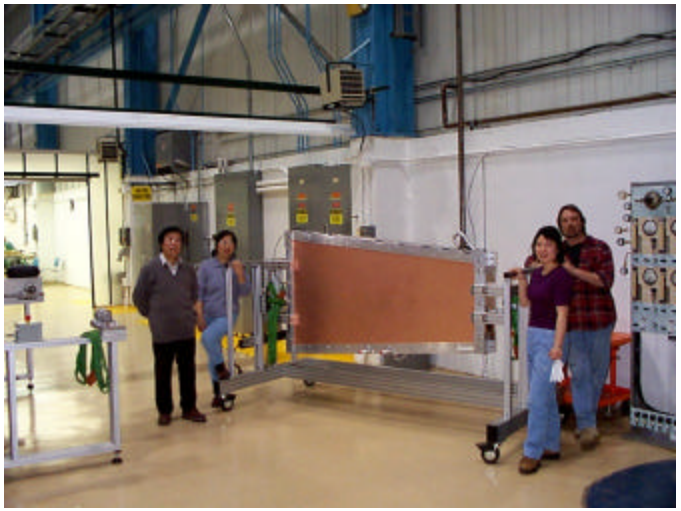
EMU Meeting

Outline

- **Preparation/Procurement Plans**
  - **FNAL Activities for:**
    - Prototypes & Tooling at Foreign Sites
    - Production at Foreign Sites
  - **Cooling Plates Procurement**
- **Other FNAL Activities**
  - **Configuration Releases**
  - **Parts Shipments**
  - **Production Tooling**
- **FNAL Production Activities**
  - **Panel production**
  - **Chamber Production**

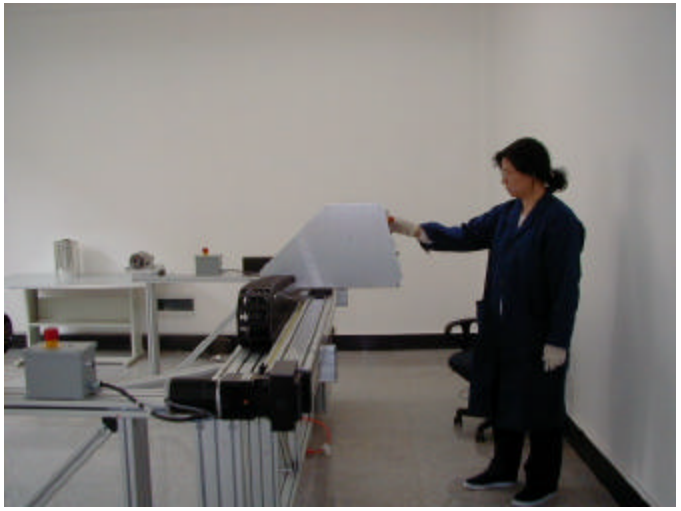
Preparation Plans

- **Prototyping Schedule**
  - ME1/2 Assembled by Jan. ‘00
  - ME2/1 Assembled by May ‘00
  - ME3/1 Assembled by Jun. ‘00
  - ME1/3 Assembled by Nov ‘00
  - 4 Pre-production ME234/2 by Jun ‘00.
  - ME4/1 Assembled by Jun ‘01



ALL PROTOTYPES COMPLETED

- **Tooling Schedule**
  - FNAL Tooling
  - PNPI Tooling
    - Setup in PNPI
  - IHEP Tooling
    - Setup in IHEP



ALL TOOLING INSTALLED AND OPERATIONAL

Preparation Plans

- **Production at PNPI**
  - **Production Readiness Review in June '01.**
  - **No major showstopper, however many technical suggestions were provided:**
    - Extra space
    - Better production flow definition
  - **All Chamber parts, frame parts and *un-cleaned* panels for ME2/1 production were shipped by the beginning of Sept. In transit through Hamburg, arrived in St. Petersburg port on Sept. 26th.**

Executive Summary

The CMS-EMU group at PNPI has made excellent progress toward the setup of the assembly factory for the ME2/1, ME3/1 and ME4/1 chambers of the CMS-EMU project. Three prototypes have been properly assembled demonstrating that the PNPI group has achieved a satisfactory level of knowledge and experience on all aspects of their assembly project, from anode panel winding to final chamber testing.

The PNPI group has presented a complete description of their proposed chamber assembly process, addressing at satisfactory level of details all the aspects of production management with the exclusion of cost management that was not part of this review.

The Committee agreed on the following general recommendation:

General Recommendation

The review Committee found no showstoppers preventing the PNPI-EMU group from moving from the prototyping to the production stage. However it is the opinion of the Committee that the achievement of the full speed production rate goal (~5 chamber/month) will require addressing many of the recommendations provided in the bulk of this document.

As a follow-up to these recommendations, the committee does not consider a second review necessary, but rather suggests PNPI prepare a document addressing the recommendations and submit it by Aug. 15th, 2001 to the EMU L2-L3 Managers and the Review Committee. The Committee will assess the responses from PNPI and will make further recommendations as appropriate.

Preparation Plans

- **Production at IHEP**
  - **Production Readiness Review in July '01 (N.Chester).**
  - **No major showstopper, however many technical suggestions were provided:**
    - Manpower allocation
    - Better production flow definition
  - **All Chamber parts, frame parts and 50% *un-cleaned* panels for ME1/2 production ready to be shipped. 50% of remaining panels to be cleaned. Shipment waiting for Custom paperwork.**

Executive Summary

The CMS-EMU group at IHEP has made excellent progress toward the setup of the assembly factory for the ME1/2 and ME1/3 chambers of the CMS-EMU project. Two prototypes have been properly assembled demonstrating that the IHEP group has achieved a satisfactory level of knowledge and experience on all aspects of their assembly project, from anode panel winding to final chamber testing.

The IHEP group has presented a complete description of their proposed chamber assembly process, addressing at a satisfactory level of detail, all the aspects of the requested production effort with the exclusion of cost management that was not part of this review.

The Committee agreed on the following general recommendation:

General Recommendation

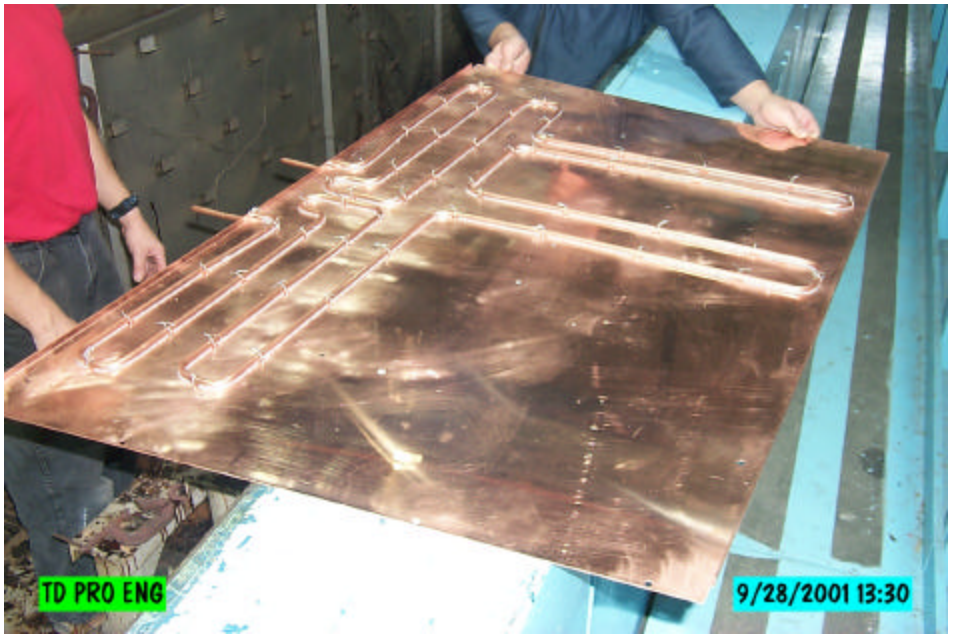
The review Committee was impressed with the progress and current status of the IHEP-EMU group and their facilities, having satisfactorily completed the assembly and testing of two prototype chambers in facilities that were felt adequate to support production activities. The committee believes that the IHEP group is ready to start building production chambers, but it believes that in order to achieve and sustain the needed peak production rate of 6 chamber/month the group will have to satisfactorily address the recommendations provided in this report.

As a follow-up to the submittal of this report of findings and recommendations, the committee suggests IHEP prepare a response to each finding and corresponding recommendation and submit it by September 15, 2001 to the EMU L2-L3 Managers and to the Review Committee. The Committee, along with the L2-L3 management, will assess the responses from IHEP and will make further recommendations as appropriate. At this time it is not felt that another pre-production Committee visit to the IHEP facilities is necessary. However, periodic follow-up visits to the IHEP facilities while chamber production and FAST site activities are in progress, by CMS management or their representatives, are strongly recommended.

Cooling Plates

- **Procurement of Cooling Plates**
  - **First ME234/2 Release (April 2001)**
    - Budgetary quotes from 3 vendors
    - Deal with lowest bidder: could not achieve the technical specs
      - **Major problem: keep flatness during the tube soldering process**
    - Progress
      - **Converged with the lowest bidder on proper soldering process (end of Sept. 2001)**
      - **Identified additional possible vendors**
  - **ME234/2 Configuration Control (September 2001)**
    - Produce 10 ME234/2 Cooling Plates at FNAL under schedule requirements
    - Order at least one prototype from every vendor willing to quote on the balance of 140 cooling plates. Bids closing by mid October.
    - No order placed before inspection of the prototype.
  - **Cooling Plates Prototypes**
    - ME2/1 Produced
    - Waiting for drawing release for ME3/1, ME4/1 and ME1/3.

Cooling Plates



Configuration Releases

- **Chamber Configuration Release**
  - Needed to allow PNPI/IHEP to finalize the chamber parts "procurement" (typically they still have to machine the frames) and allow them to go into chamber production.
  - Frame finalization intimately connected to Integration finalization (ex: ME1/2)
    - ME234/2 CC in Spring 2000
    - ME2/1 CC in Sep. 2001
    - ME1/2 to be placed under CC shortly
- **Integration Configuration Release**
  - Needed to start parts procurement, mostly at FNAL and U. Wisc.
    - ME234/2 CC in August 2001
    - ME1/2 to follow shortly
    - ME2/1 to follow shortly

Configuration: 1 Release Date: 9/13/2001
Revision: 0 Revision Date:

Changed Rev. (*)	Size	Dwg. No.	Rev.	Description
**	ME-	368219	D	Frame Assembly
	ME-	368172	A	Extrusion, Top Small End
	ME-	368173	A	Extrusion, Bottom Small End
	ME-	368174	B	Extrusion, Top Anode Side
	ME-	368175	B	Extrusion, Bottom Anode Side
*	ME-	368176	C	Extrusion, Top HV Side
	ME-	368177	B	Extrusion, Bottom HV Side
	ME-	368178	B	Extrusion, Top Big End
	MD-	368179	A	Extrusion, Bottom Big End
	MB-	368180	B	Panel, Small End
	MC-	368181	B	Panel, HV side
	MC-	368182	B	Panel, Big End
	MB-	368074	C	Plate, Big End
	MB-	368075	B	Plate, Small End
	MD-	368422	A	Panel, Anode Side

(*) Change Description: As Released for Production;
Test strip connector mounting holes must be installed at PNPI
** Major sub-assembly components listed below this item.

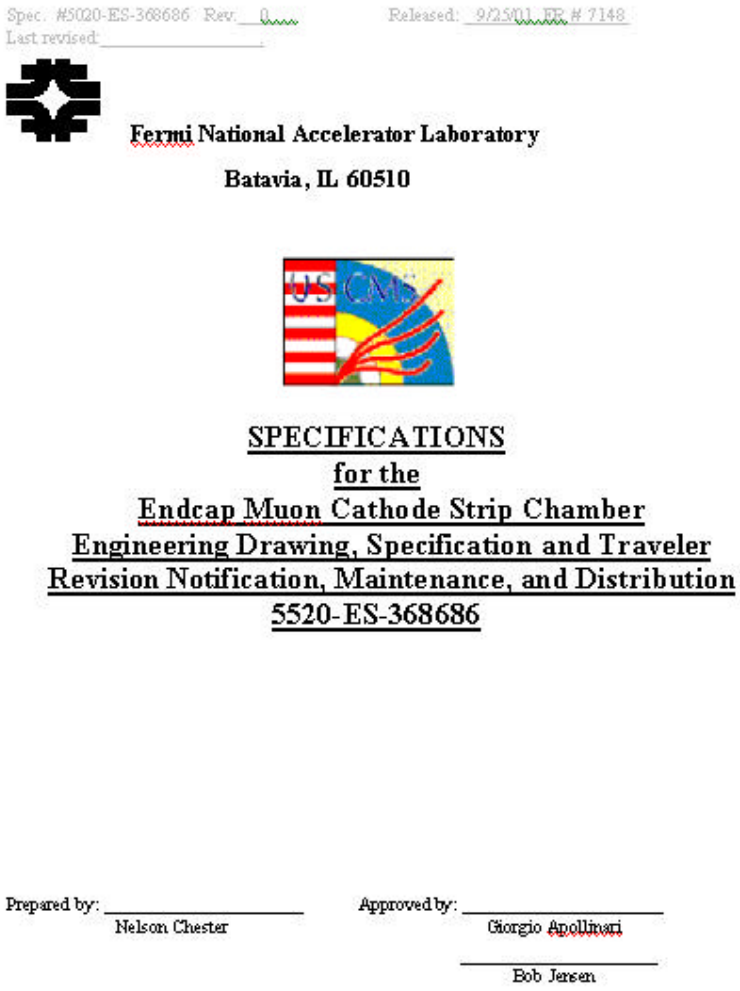
******** Approvals: ********
(primary/alternate)

Proposed by:	Approved by:	
N. Chester	Gena Mitselmakher/Andrey Korytov	★
	Andrey Korytov/Gena Mitselmakher	★
Prepared by:	Richard Loveless/Farshid Feyzi	★
N.Chester	T Y Ling/Tom Fergusen	T. Fergusen (by Email)

http://tdserver1.fnal.gov/project/uscmsemu/Configuration_Control_Documents/Released_Configurations/

Configuration Releases (cont.)

- **Configuration Release Communication to Foreign Sites**
  - **Procedure in place to let foreign sites know about released Configuration**
    - Initial released Configuration to be transmitted by CD.
    - Foreign site responsible to update drawings in their possession if/when new Configurations are approved.
- **Process (Travelers) Changes communication to Foreign Sites**
  - **Procedure in place to let foreign sites know about Assembly process changes at FNAL.**
    - Initial released Configuration to be transmitted by CD.
    - Foreign site responsible to *translate* and update travelers in their possession for their own purposes.



Spec. #5020-ES-368686 Rev. 0 Released: 9/25/01 EE # 7148
Last revised:

Fermi National Accelerator Laboratory

Batavia, IL 60510

SPECIFICATIONS
for the
Endcap Muon Cathode Strip Chamber
Engineering Drawing, Specification and Traveler
Revision Notification, Maintenance, and Distribution
5520-ES-368686

Prepared by: Nelson Chester

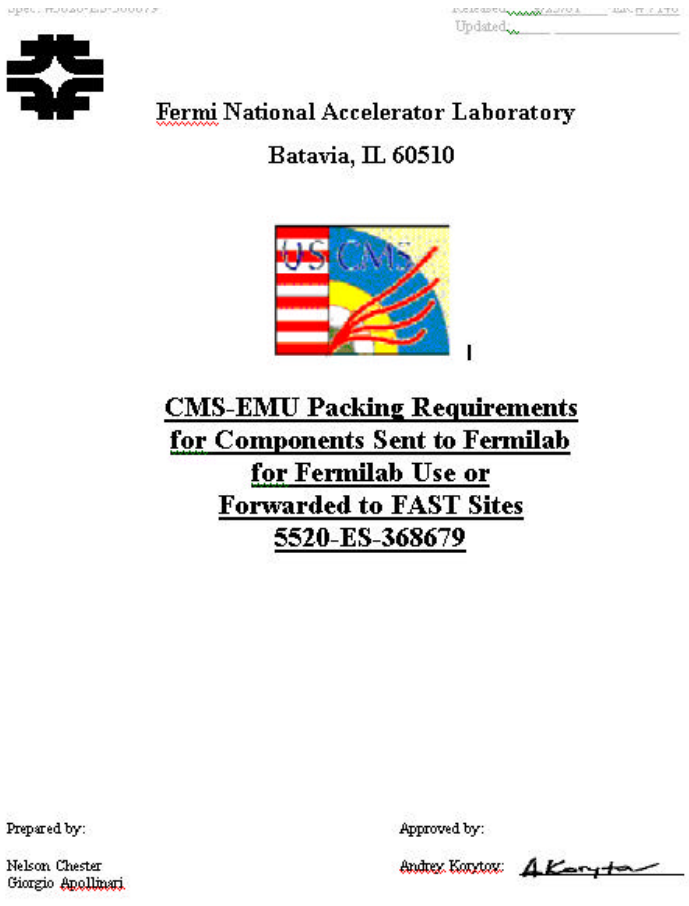
Approved by: Giorgio Apollinari

Bob Jensen

http://tdserver1.fnal.gov/project/uscmsemu/Released_Specifications/Chamber_Specifications/

Parts Shipment

- **Completed instructions for parts shipped to Foreign Sites through FNAL, to be enforced by L3 Manager (A.K.) which obtained all agreements.**
- **Major points:**
  - **Pre-packed boxes not opened at FNAL.**
  - **Full *List of Parts* attached on multiple sides of the box.**
  - **Unit Value & Weight.**
  - **Description of where the part is shipped to with reference on which chamber it is going to be used.**
  - **Etc….**



Updated

Fermi National Accelerator Laboratory

Batavia, IL 60510

CMS-EMU Packing Requirements for Components Sent to Fermilab for Fermilab Use or Forwarded to FAST Sites 5520-ES-368679

Prepared by:

Nelson Chester
Giorgio Apollinari

Approved by:

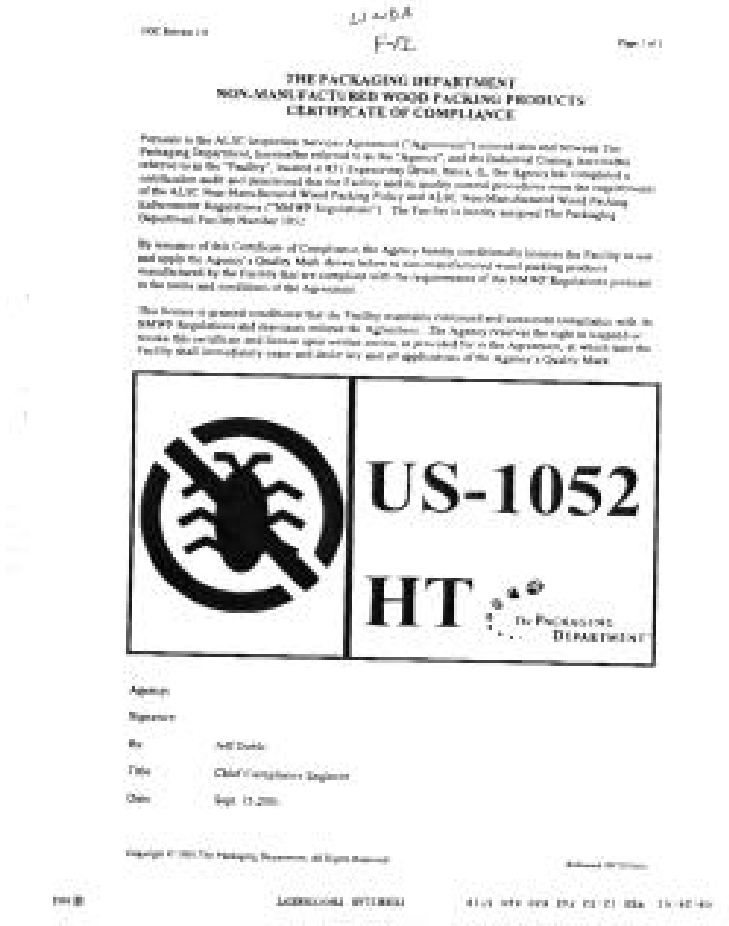
Andrey Korytov:

- **CR still to be approved *(almost ready to receive boxes, but not quite)***

http://tdserver1.fnal.gov/project/uscmsemu/Released_Specifications/Chamber_Specifications/

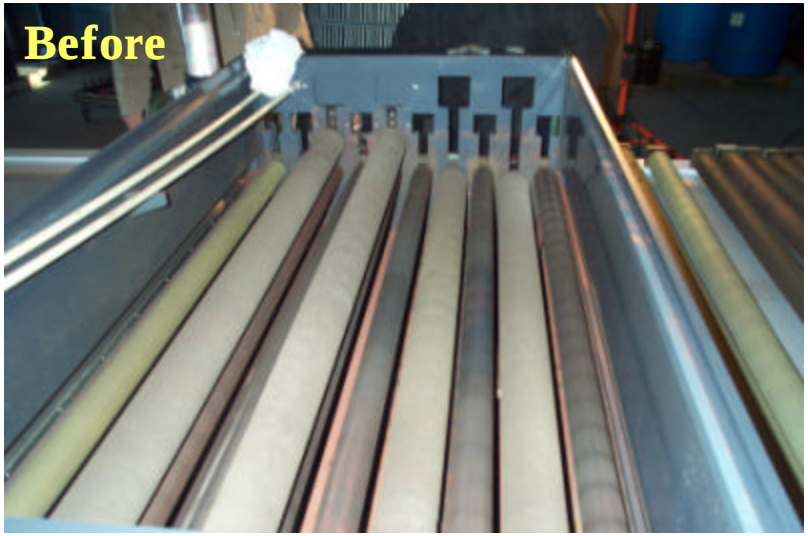
Chamber Shipments

- New EU requirements on measures for NMWP (Non-Manufactured Wood Packing) materials allow three treatment options:
  - Heat Treatment
  - Fumigation
  - Chemical Pressure Impregnation
- The shipping containers manufacturing company has recently obtained the certification from the ALSC (American Lumber Standard Committee).
  - Wood ~ 30% more expensive, ~5-15% increase in cost for shipping containers.
- Option for 35 chambers at FAST Sites
  - Fumigation by Commercial Pest Control Company to kill Pine Wood Nematode
  - Remaking of ~35 Shipping Containers
  - Heat Treating the ~35 Shipping Containers


THE PACKAGING DEPARTMENT
NON-MANUFACTURED WOOD PACKING PRODUCTS
CERTIFICATE OF COMPLIANCE

US-1052
HT
THE PACKAGING DEPARTMENT

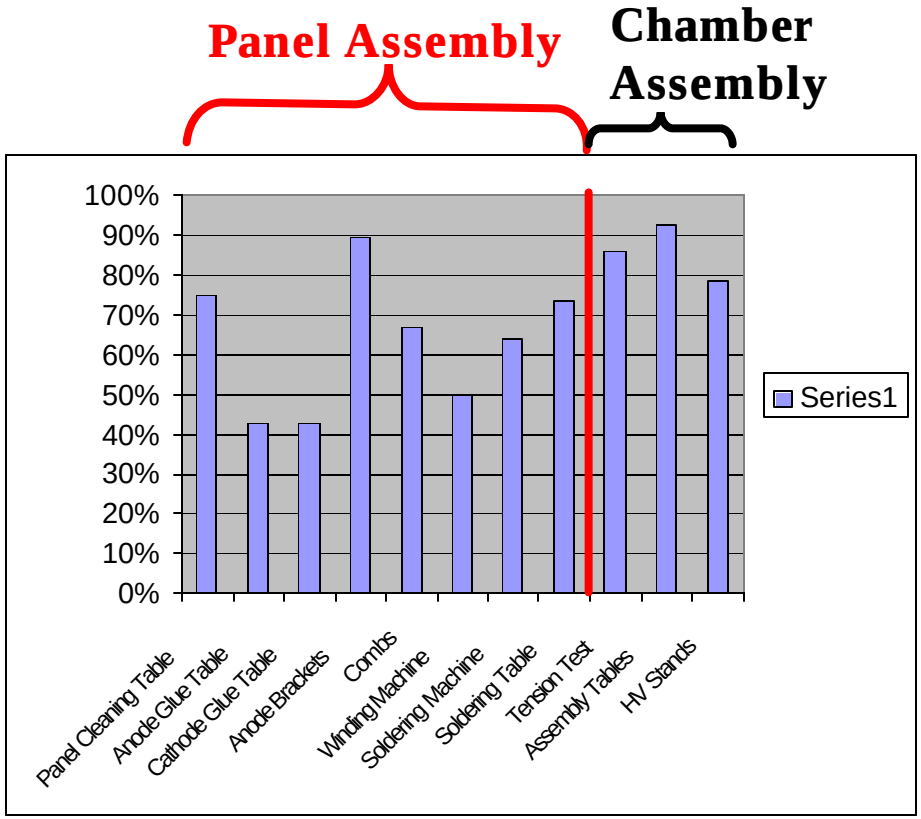
Production Tooling



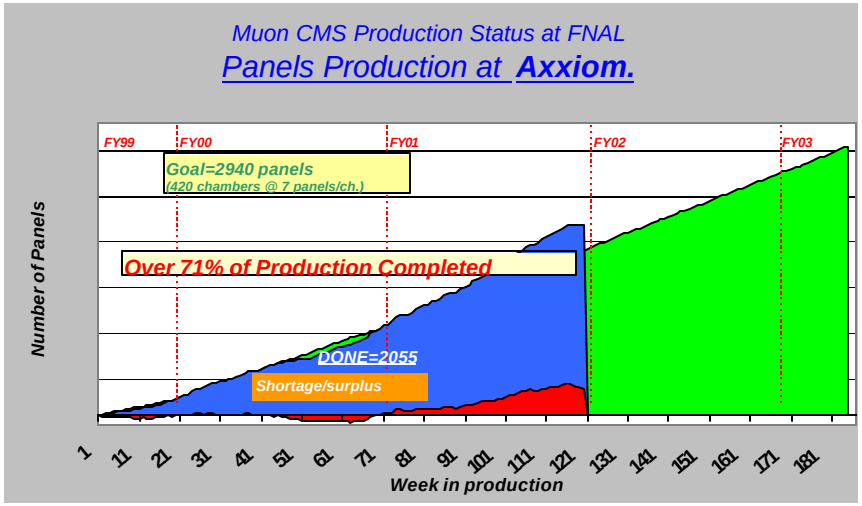
- **Cleaning Machine**
  - **Redesigned and fabricated almost from scratch**
    - Not adequate deburring
    - Falling apart (PVC construction)
  - **Substituted 8 polishing brushes with 2 deburring and 2 polishing brushes**
  - **Various *ups-and-downs*, presently in an *ups* stage (N.C.)**

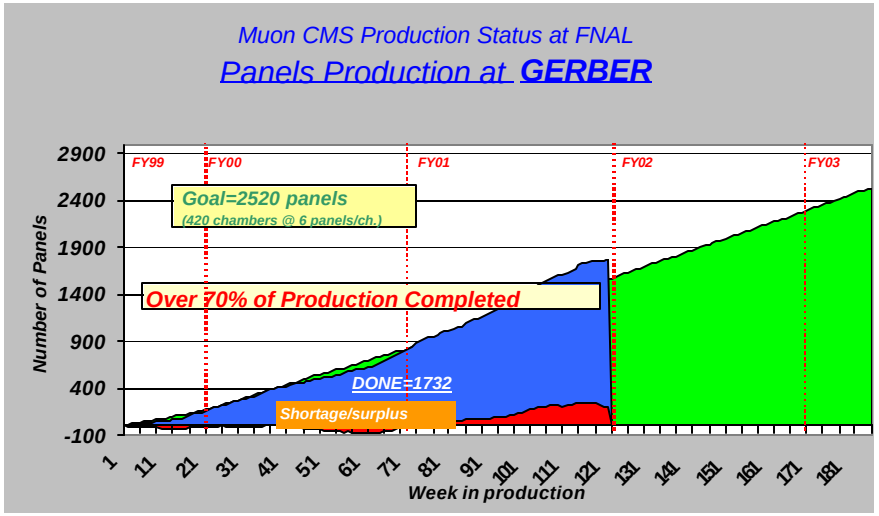
Production Tooling (cont.)

- **MP9 Tooling**
  - **MP9 in steady-state production mode since ~ beginning of 2001**
  - **Analysis of tools usage**
    - Daily, random visits to production floor recording particular tools usage
    - Mostly biased to record an under-usage of tooling.
- **Deficiencies/Bottlenecks in**
  - **Anode Panel Brackets (used for assembly process and panel storage)**
    - Extra being fabricated
  - **Chamber Assembly Area**
    - Multifaceted problem
    - Started addressing by increasing the number of HV testing units.



FNAL Factories Status





Panel Machining in full-speed production as of ~ Jan '00

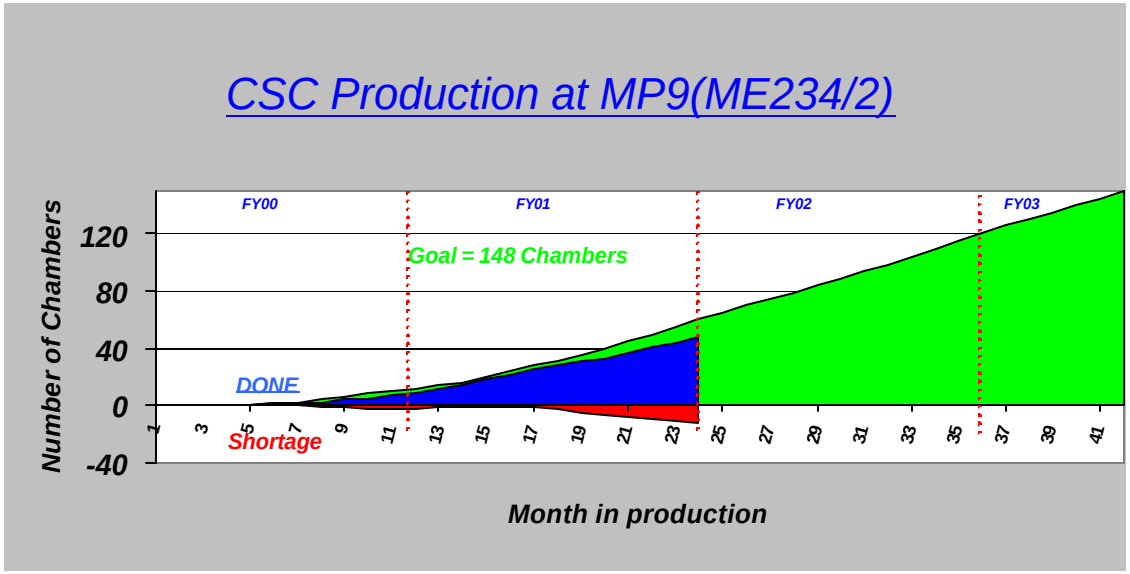
- Production goal for FY'00 obtained with the expected manpower.
- In FY'01, the production rate is well above expectations with minimal additional manpower (3.2 FTE used vs. 2.5 FTE expected)
- Completed machining of ME234/2 panels (FNAL Production)
- Completed machining of ME2/1 & ME3/1 panels (66% of PNPI Production)
- Completed machining of ME1/2 panels (50% of IHEP Production)
- Starting machining of ME4/1 panels (completion expected by Dec. '01)
- Finish machining on ME1/3 panels (completion expected by Jun '02) and spares

COMPLETED 70% of PANEL PRODUCTION

FNAL Factories Status

- **45 ME234/2 Production Chambers assembled (30%)**

FY	Week	From	To	Total ME234/2	Total ME1/2	Total ME2/1	Total ME1/3	Total ME3/1	Total ME4/1
FY00	October	10/1/1999	10/31/1999	-	-	-	-	-	-
	November	11/1/1999	11/30/1999	-	-	-	-	-	-
	December	12/1/1999	12/31/1999	-	-	-	-	-	-
	January	1/1/2000	1/31/2000	-	1	-	-	-	-
	February	2/1/2000	2/28/2000	-	1	-	-	-	-
	March	3/1/2000	3/31/2000	1	-	-	-	-	-
	April	4/1/2000	4/30/2000	1	-	-	-	-	-
	May	5/1/2000	5/31/2000	-	-	-	-	-	-
	June	6/1/2000	6/30/2000	2	-	-	-	1	-
	July	7/1/2000	7/31/2000	1	-	-	-	-	-
	August	8/1/2000	8/31/2000	2	-	-	-	-	-
	September	9/1/2000	9/30/2000	2	-	-	-	-	-
	FY00 Summary			9	2	-	-	1	-
	Grand Total			9	2	-	-	1	-
FY01	October	10/1/2000	10/31/2000	3	-	-	-	-	-
	November	11/1/2000	11/30/2000	3	-	-	1	-	-
	December	12/1/2000	12/31/2000	3	-	-	-	-	-
	January	1/1/2001	1/31/2001	4	-	-	-	-	-
	February	2/1/2001	2/28/2001	4	-	-	-	-	-
	March	3/1/2001	3/31/2001	3	-	-	-	-	-
	April	4/1/2001	4/30/2001	2	-	-	-	-	-
	May	5/1/2001	5/31/2001	2	-	-	-	-	-
	June	6/1/2001	6/30/2001	4	-	-	-	-	1
	July	7/1/2001	7/31/2001	4	-	-	-	-	-
	August	8/1/2001	8/31/2001	3	-	-	-	-	-
	September	9/1/2001	9/30/2001	4	-	-	-	-	-
	FY01 Summary			39	-	-	1	-	1
	Grand Total			48	2	-	1	1	1
FY02	October	10/1/2001	10/31/2001	-	-	-	-	-	-
	November	11/1/2001	11/30/2001	-	-	-	-	-	-
	December	12/1/2001	12/31/2001	-	-	-	-	-	-
	January	1/1/2002	1/31/2002	-	-	-	-	-	-
	February	2/1/2002	2/28/2002	-	-	-	-	-	-
	March	3/1/2002	3/31/2002	-	-	-	-	-	-
	April	4/1/2002	4/30/2002	-	-	-	-	-	-
	May	5/1/2002	5/31/2002	-	-	-	-	-	-
	June	6/1/2002	6/30/2002	-	-	-	-	-	-
	July	7/1/2002	7/31/2002	-	-	-	-	-	-
	August	8/1/2002	8/31/2002	-	-	-	-	-	-
	September	9/1/2002	9/30/2002	-	-	-	-	-	-
	FY02 Summary			-	-	-	-	-	-
	Grand Total			48	2	-	1	1	1
FY03	October	10/1/2002	10/31/2002	-	-	-	-	-	-
	November	11/1/2002	11/30/2002	-	-	-	-	-	-
	December	12/1/2002	12/31/2002	-	-	-	-	-	-
	January	1/1/2003	1/31/2003	-	-	-	-	-	-
	February	2/1/2003	2/28/2003	-	-	-	-	-	-
	March	3/1/2003	3/31/2003	-	-	-	-	-	-
	April	4/1/2003	4/30/2003	-	-	-	-	-	-
	May	5/1/2003	5/31/2003	-	-	-	-	-	-
	June	6/1/2003	6/30/2003	-	-	-	-	-	-
	July	7/1/2003	7/31/2003	-	-	-	-	-	-
	August	8/1/2003	8/31/2003	-	-	-	-	-	-
	September	9/1/2003	9/30/2003	-	-	-	-	-	-
	FY03 Summary			-	-	-	-	-	-
	Grand Total			48	2	-	1	1	1



Production

- 3 chambers ready, failing new leak rate spec
- One chamber to be re-built (006)

Rate

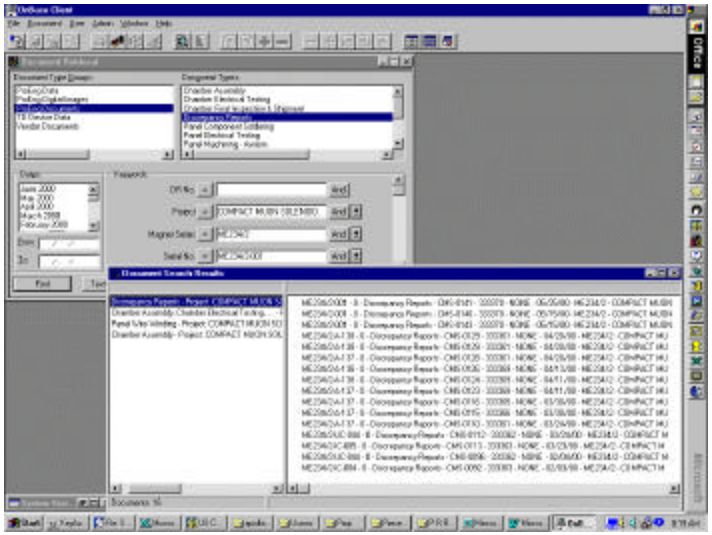
- 3.25 Chamber/ month in FY01
- 4 chambers on a *Good Month*
- *2* chamber on a *Bad Month*

FNAL Factories Status

- **Production Issues**
  - **Goal of increasing output to 4 Chambers/month on average in FY02 with baseline (7 techs) manpower in MP9.**
    - ME234/2 Production completed by Nov. 2003.
  - **Goal to convince L2-L3 to augment the efficiency of manpower usage in MP9 by closing the program of visitors training and using the available funding to increase the trained assembly personnel.**
    - With 8 techs in MP9 the production rate could probably increase to 4.5 Chambers/month by the time the full work-force is fully trained (~March ’02).
    - ME234/2 Production would be completed by Aug. 2003.

Chamber Production Experience

- **New Lesson**
  - **One case of bad wire**
    - Corona on 2 planes
    - Gold flakes on wire
  - **No new case/additional problems with same batch spools reported since then.**



- **Discrepancy Report (DR) summary (ME234/2-003 to ~~016~~ ~~027~~ 051)**
  - **Average: ~~5DR/Chamber (73 DRs)~~ ~~3.8 DR/Chamber (105 DRs)~~**

    3.2 DR/Chamber (162 DRs)
  - **Most DR: ~~ME234/2-006 with 11 DRs~~**
  - **Least DR: Many Chambers with 0 DRs**
  - **Most Consistent Cause: Wire position**
  - **Most Dramatic/Scary Problem: RTV mixing/Flaking Wire**

FNAL FY01 Milestones

	Program Milestones	Baseline Milestone Date	Current Milestone Date	Status
1.2.12.1.1	8 ME23/2 Elec/Mech Kits to UCLA		05/25/01	
1.2.12.1.2	12 ME23/2 Elec/Mech Kits to UCLA		08/24/01	Canceled
1.2.12.2.1	8 ME23/2 Elec/Mech Kits to UF		05/25/01	
1.2.12.2.2	12 ME23/2 Elec/Mech Kits to UF		08/24/01	
1.2.12.3.1	6 ME2/1Elec/Mech Kits to PNPI		07/20/01	Delayed
1.2.12.3.2	12 ME2/1Elec/Mech Kits to PNPI		08/24/01	Delayed
1.2.12.6.1	6 ME1/2 Elec/Mech Kits to IHEP		05/25/01	Delayed
1.2.12.6.2	12 ME1/2 Elec/Mech Kits to IHEP		08/24/01	Delayed
1.8.1.1.3.11	P4' (ME1/2) Prototype at IHEP is assembled		03/30/01	Achieved
1.8.1.1.10	ME1/2, ME1/3 Final Design		11/30/00	ME1/2 Achieved
1.8.1.1.21	Sign off ME1/2 Drawings		12/07/00	Achieved
1.8.1.1.22	Sign off ME2/1 Drawings		12/01/00	Achieved
1.8.1.1.23	Sign off ME1/3 Drawings		06/01/01	Not achieved
1.8.1.1.24	Sign off ME3/1 Drawings		02/01/01	Achieved (de facto)
1.8.1.1.26	Sign off ME4/1 Drawings		03/01/01	Not Achieved
1.8.4.2.10	+42=64 ME23/2, 20 ME23/1, 36 ME1/23 panels made		10/01/00	Achieved

FNAL FY01 Milestones (2)

	Program Milestones	Baseline Milestone Date	Current Milestone Date	**Status**
1.8.9.1.1.2	16 ME23/2s assembled at Fermilab		12/01/00	**Achieved**
1.8.9.1.1.3	28 ME23/2s assembled at Fermilab		03/09/01	**Achieved**
1.8.9.1.1.4	40 ME23/2s assembled at Fermilab		05/25/01	**Achieved**
1.8.9.1.1.5	52 ME23/2s assembled at Fermilab		08/10/01	**~10 CSC behind**
1.8.9.1.2.2	1 Chamber shipped to UCLA FAST Site		12/01/00	**Achieved**
1.8.9.1.2.3	6 Chambers shipped to UCLA FAST Site		01/12/01	**Achieved**
1.8.9.1.2.4	6 Chambers shipped to UCLA FAST Site		03/16/01	**Achieved**
1.8.9.1.2.5	6 Chambers shipped to UCLA FAST Site		06/08/01	**Achieved**
1.8.9.1.2.6	6 Chambers shipped to UCLA FAST Site		08/17/01	**Ready to send**
1.8.9.1.3.2	1 Chamber shipped to UF Fast Site		12/01/00	**Achieved**
1.8.9.1.3.3	6 Chambers shipped to UF Fast Site		01/12/01	**Achieved**
1.8.9.1.3.4	6 Chambers shipped to UF Fast Site		03/16/01	**Achieved**
1.8.9.1.3.5	6 Chambers shipped to UF Fast Site		06/08/01	**Achieved**
1.8.9.1.3.6	6 Chambers shipped to UF Fast Site		08/17/01	**Ready to send**
1.8.9.2.1	12 ME2/1 CSC kits are shipped to PNPI		01/10/01	**Achieved**
1.8.9.2.2	26 ME2/1 CSC kits are shipped to PNPI		05/10/01	**Achieved**
1.8.9.3.1	12 ME1/2 CSC kits are shipped to IHEP		01/10/01	**~Achieved**
1.8.9.3.2	30 ME1/2 CSC kits are shipped to IHEP			**~Achieved**

Conclusion

- **FNAL Factories**
  - **Activities proceeding according to plans.**
  - **Panel Production activities almost completed.**
  - **Some "catch-up" activities and technical specification changes have caused ~20% delays on Chamber Production activities.**
    - No-cost remedies can still be implemented to retrieve some of the lost schedule.
    - Studying ways to ramp up to meet April 2003 Completion date.
- **FNAL Shipment Activities**
  - **Chamber & Un-machined Frame Parts Shipments proceeding according to the new plans.**
    - PNPI Shipment at destination
    - IHEP Shipment almost ready.
  - **FAST Sites *"Part Flow"***
    - FNAL to act as *"expeditioner"*, waiting for PO approval.